AusNet Gas Services Pty Ltd

Gas Access Arrangement Review 2018–2022

Appendix 11A: Program of Works – Network Innovation Projects

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Program of Works

Network Innovation Projects

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1 Summary

PROGRAM	Network Innovation Scheme
SERVICE DATE	On-going throughout period 2018 – 2022
LOCATION	Various AusNet Services' gas transmission & distribution network
VALUE	$ 4.93M

2 Program Scope

This program comprises four innovation projects that involve research, development and demonstration of new equipment that has not been proved in Australia. These projects have the potential to improve the operation of the network and deliver benefits to gas customers.

The projects are:

- Drone pipeline inspection and leak detection;
- Hydrogen network assessment;
- Water extraction camera; and
- Portable storage systems.

2.1 Drone pipeline inspection and leak detection

This project will involve the use of a drone fitted with thermal detection capability to inspect pipelines. Thermal detection will allow temperature differences between fluid/gas and soil to be detected and therefore provide the information necessary to detect leaks. Further, the data collected by the imaging device could enable the monitoring of flora and fauna as required to meet environmental requirements.

The use of drones to inspect assets is not new, however the application of drones to detect gas leaks and monitor easements is untested on Australian gas networks. The proposed program phases are shown in

Table 1.

A report will be prepared at the completion of the trial that describes the trial and the findings from the trial. The report will be made available on the AusNet Services website so that stakeholders and interested parties (such as equipment suppliers and other gas distribution businesses) have access to the findings of the trial. AusNet Services also commits to sharing the learnings from this project through industry working groups and forums.

Table 1: Project phases – Pipeline inspection and leak detection

Project phase	Activities	Questions to be answered
Design	Prepare project plan Identify suitable drone and detection equipment Identify area (pipeline) for trial Determine regulatory constraints and permits for trial Determine scope of data analysis	What are the constraints that limit the operation of a drone to inspect gas pipelines? What permits are required to operate a drone to inspect gas pipelines? What are the equipment specifications necessary to undertake leak detection and inspection? What software tools are available to undertake data analysis

Project phase	Activities	Questions to be answered
	(image processing)	and processing?
Trial	Prepare safety plan for trials Undertake test flights and data capture in unconstrained area (non-pipeline) Test flight over pipeline (data capture test) Test flights over pipelines to provide range of data for analysis	What skills and experience are necessary to fly a drone and collect satisfactory data for analysis? What are the limits to flying an inspection drone over pipelines (height, distance, time etc.)? How much data is generated from drone inspection? How easily can data be collected and transferred for processing?
Data processing	Configure software for image processing Process test batches of image data	How effective is commercially available software in providing leak detection? What level of software configuration is required? Can leak detection and environmental monitoring analysis be carried out simultaneously? What software development would be necessary to move data processing to production? What level of effort (cost) is required to process data?
Report	Prepare report of trial findings Publish report of trial findings	Is drone inspection of pipelines to detect leaks feasible? Can data gathered during leak detection be economically used to environmentally monitor pipelines? What equipment, software, systems and skills are necessary to move from trial to production?

2.1.1 Project Budget

The estimated component costs of the project are shown in Table 2.

Table 2: Estimated costs – Pipeline inspection and leak detection

Project Management	$180k
Design	$180k
Drone & camera hardware	$400k
Data processing software/configuration	$600k
Labour – flying & data analysis	$540k
Report	$100k
TOTAL	**$2,000k**

2.2 Hydrogen network assessment

Gas transmission and distribution networks could be converted to deliver hydrogen to customers. Hydrogen can be used as a substitute for natural gas and has the benefit of burning (and creating heat) without generating carbon dioxide.

This project is a research project that involves identifying the constraints and barriers to the introduction of hydrogen to existing gas transmission and distribution networks. The project will focus on three areas; hydrogen supply, transport and use. The supply and use of hydrogen have been included in the project as the evaluation of the feasibility of using existing pipelines to transport hydrogen is of very limited value unless hydrogen is available and consumers can use the fuel.

The project is intended to create a platform for further detailed examination of hydrogen as a substitute for natural gas in Victoria. The research will identify the likely nature and location of hydrogen supply, the scale of investment necessary to transport the fuel to end users, and the feasibility of converting appliances to utilise hydrogen.

The research would consider a range of publicly available information on trials and development of hydrogen plants, pipelines and consumption worldwide. This is likely to include engaging the proponents of these trials and developments to understand the details of the work undertaken and the findings. Further, the project is likely to engage with parties such as gas consumer equipment suppliers to assess the potential for hydrogen fuel to be developed. The proposed program phases are shown in Table 3.

A report will be prepared at the completion of the trial that describes the research and findings. The report will be made available on AusNet Services' website so that stakeholders and interested parties (such as upstream gas producers, consumer appliance suppliers and other gas distribution businesses) have access to the findings of the trial. AusNet Services also commits to sharing the learnings from this project through industry working groups and forums.

Table 3: Project phases – Hydrogen network assessment

Project phase	Activities	Questions to be answered
Supply	Identify technology options for hydrogen supply plant. Investigate feasibility of various capacity hydrogen supply plants. Describe the likely locations of hydrogen supply plant(s) in Victoria. Describe key features that differ between hydrogen supply and natural gas supply.	What technologies exist to generate utility scale volumes of hydrogen and how mature are these technologies? Is there an optimal size for a hydrogen supply plant (in Victoria)? Does the likely size of hydrogen supply plants lend itself to a configuration involving multiple plants in multiple locations such as embedded in the distribution network? If a large plant is more feasible, where is the most likely location for a hydrogen supply plant in Victoria? How would emissions from the plant be sequestered or eliminated? Could hydrogen be simply substituted for natural gas without further storage or processing?
Network	Model network capacity in transmission and distribution pipelines. Assess impact of transporting hydrogen on pipelines, pressure conversion equipment and measurement devices. Develop options for conversion of network from natural gas to hydrogen	Would the network need significant augmentation to transport the same energy volume of hydrogen as natural gas? Which network components and equipment would need to be replaced or altered to enable hydrogen transport? How could the network be converted to supply hydrogen with minimal impact on customers?

Project phase	Activities	Questions to be answered
Use	Identify key uses of natural gas and equipment used. Describe likely method of converting equipment to use hydrogen fuel. Identify any processes or natural gas use for which hydrogen is not a suitable substitute.	How would equipment such as heaters and cookers be adapted to utilise hydrogen? Are there particular types or classes of equipment that could not be converted and would need to be replaced? Which types of natural gas consumers could not use hydrogen as a substitute fuel?
Safety	Identify differences in risk between transport and use of natural gas and hydrogen. Describe likely safety elimination or mitigation measures required to safely transport and use hydrogen.	Does the use and transport of hydrogen produce materially different risks from the use of natural gas? If so, how could these risks be eliminated or mitigated?
Report	Prepare report of research findings Publish report of research findings.	What areas of the production, transport and use of hydrogen and technically advanced and/or well developed? In which areas should future R&D into the use of hydrogen as a substitute for natural gas be focussed? Are there any overwhelming constraints to the conversion of the natural gas network to hydrogen?

2.2.1 Project Budget

The estimated component costs of the project are shown in Table 4.

Table 4: Estimated costs – Hydrogen network assessment

Project Management	$50k
Supply	$150k
Network modelling	$50k
Network technical	$100k
Use	$150k
Safety	$50
Report	$80k
TOTAL	**$630k**

2.3 Water extraction camera

Water ingress in lower pressure pipelines is a major cause of customer supply interruptions. A camera can be mounted on a push rod along with a suction device to extract any water detected in the pipeline. This technology has been developed in prototype form overseas but has not been trialled on pipelines of the type and construction present in AusNet Services' network.

The project will involve the use of a system with a flexible push rod, camera and water extraction device that can be readily inserted into lower pressure networks to identify water that is blocking the pipeline. The operator will view a screen which presents the images from the camera, allowing the operator to activate the pump and extract the water to remove the blockage.

The proposed program phases are shown in Table 5.

A report will be prepared at the completion of the trial that describes the trial and the findings from the trial. The report will be made available on the AusNet Services website so that stakeholders and interested parties (such as equipment suppliers and other gas distribution businesses) have access to the findings of the trial. AusNet Services also commits to sharing the learnings from this project through industry working groups and forums.

Table 5: Project phases – Water extraction camera

Project phase	Activities	Questions to be answered
Design	Prepare project plan. Identify potential supplier(s) of technology. Assess advantages & disadvantages of each technology. Identify most likely network locations for trial.	Is there more than one supplier who can trial this technology? What limitations and constraints are placed on the trial by the available technology? From which network location would we learn the most from a trial?
Engage	Prepare trial specification. Arrange contract with technology supplier including supply of equipment & personnel to train and operate. Arrange timing of trial	Are there any specific commercial and legal risks associated with the use of this technology? Can equipment suppliers provide a full range of services to support the trial and ongoing use of equipment?
Trial	Prepare safety plan for trials. Undertake on site trials at multiple locations incorporating differing pipeline materials and designs.	Can the technology be efficiently used to identify water in AusNet Services' pipelines? Is the water extraction effective? What training & skills are necessary to operate the equipment? What limitations do our network construction & configuration place on use of the technology?
Report	Prepare report of trial findings. Publish report of trial findings.	Is a camera and water extraction system effective and efficient on AusNet Services' network? Would a camera and water extraction system be effective in reducing customer supply interruptions? Should a camera and water extraction system be deployed proactively or reactively and in what circumstances?

2.3.1 Project Budget

The estimated component costs of the project are shown in Table 6.

Table 6: Estimated costs – Water extraction camera

Project Management	$100k
Procurement	$20k
Rental (or purchase) of equipment	$420k
Travel & shipping	$40k
On-site trial, training & evaluation	$420k
Report	$100k
TOTAL	**$1,100k**

2.4 Portable storage system

Customer supply is interrupted during proactive and reactive work on the gas network. Some of these supply interruptions could be avoided by the use of a portable storage system. This system would provide gas supply to a group of customers (or a single larger customer) when network works are necessary.

The project will involve examination of all the aspects of the provision of gas to customers on a temporary basis; safety, regulatory, legal, commercial and technical. It is likely that a number of regulatory, legal and commercial constraints could prevent the provision of gas supply to customers by a network business. The project will examine these aspects to determine what arrangements are necessary to supply gas in both a trial situation and on an ongoing basis.

If the regulatory, legal and commercial constraints can be overcome, the project will proceed to a technical trial which will involve specification and procurement of a portable gas supply system suited to AusNet Services' gas network. The final stage of the trial involves preparation of a report that describes the trial and the findings from the trial. The report will be made available on the AusNet Services website so that stakeholders and interested parties (such as equipment suppliers and other gas distribution businesses) have access to the findings of the trial. AusNet Services also commits to sharing the learnings from this project through industry working groups and forums.

The proposed program phases are shown in

Table 7.

Table 7: Project phases – Portable storage system

Project phase	Activities	Questions to be answered
Planning	Prepare project plan Engage safety regulator	Are there specific safety regulations or requirements that would prevent a trial of portable storage? Are there specific safety requirements (such as Gas Safety Case) that require amendment?
Legal and regulatory	Assess regulatory obligations relating to temporary supply of gas Define contractual arrangements necessary to supply portable gas to network customers	What are the legal and regulatory impediments to supply customers with gas from portable storage? What contracts are necessary to temporarily supply gas from portable storage? Can temporary arrangements be made to undertake a trial of portable storage? What regulation changes and contracts are necessary to supply customers from portable storage?
Procurement	Develop technical specification for storage system Engage supplier of storage system	What are the trade-offs between capacity and useability of portable storage? Can a portable storage system be readily procured to meet Australian Standards?
Trial	Install portable system and several network locations in test conditions Install portable system during planned work on network	What are the technical issues relating to the use of portable storage on the network? In which conditions can portable storage best be utilised (e.g. no of customers, network type, work type)? What costs are associated with the use of portable storage?
Report	Prepare report of trial findings Publish report of trial findings	Is portable storage a cost effective method of maintaining supply to customers during work on network? In what circumstances is portable storage most effective?

2.4.1 Project Budget

The estimated component costs of the project are shown in Table 8.

Table 8: Estimated costs – Portable storage system

Project Management	$100k
Legal and regulatory	$300k
Specification & procurement of equipment	$400k
On-site trials	$300k
Report	$100k
TOTAL	**$1,200k**

3 Program Benefits

The benefits from the trials are primarily answers to the questions outlined in section 2. Answering these questions provides the information necessary to decide whether to proceed with operational implementation of the technology and/or system or where to direct further R&D effort. This includes information about:

- Costs;
- Benefits;
- Limitations;
- Constraints;
- Feasibility; and
- Operational requirements.

Each of the projects has the potential to have a direct impact on AusNet Services' network or the operations of the network and involves the research, development and demonstration of at least one of the following:

a. A specific piece of new equipment in Australia (unproven in Australia);
b. A specific novel arrangement or application of existing equipment;
c. A special novel operational practice directly in relation to the operation of the Australian gas transportation system; or
d. A specific novel commercial arrangement.

The Network Incentive Criteria that each project meets is shown in Table 9.

Table 9: Network incentive criteria assessment

Project	Criteria
Drone pipeline inspection and leak detection	A specific piece of new equipment in Australia (aerial gas leak detection) and a specific application of existing equipment (drone)
Hydrogen network assessment	A specific novel application of existing equipment
Water extraction camera	A specific piece of new equipment in Australia
Portable storage system	A specific novel arrangement and application of existing equipment

A number of long-term benefits would result from implementation of the projects following successful trials. The beneficiaries include network customers, other network operators and AusNet Services. A description of the likely benefits arising from operational implementation of the tested technologies is provided in the following section. Quantification of benefits would be undertaken following trials and prior to adoption of the technology into the operating environment.

3.1 Drone pipeline inspection and leak detection

The primary benefits from the implementation of drone pipeline inspection and leak detection are safety and cost related.

Gas leaks present significant safety risks. Safety benefits arise from the detection of leaks and avoidance of adverse outcomes from gas leaks such as fire.

Transmission pipelines are physically patrolled several times each week. These patrols aim to detect any physical work on or near the pipelines which have the potential to damage pipelines leading to leaks. Additionally, each transmission pipeline is 'walked' annually and high-risk distribution mains are surveyed annually. These surveys utilise gas detectors to identify leaks.

The use of drones would replace some of the existing inspection activities and would allow more distribution mains to be economically inspected. Safety would improve as some inspections that are currently carried out without leak detection capabilities would be carried out with leak detection capabilities and, some pipeline that is not currently inspected for leaks would be inspected.

The cost of drone inspection is expected to be lower than current inspection techniques resulting in lower inspection costs.

Customers would benefit from the implementation of drone inspection as their risk exposure would reduce through earlier and more accurate identification of leaks. Customers' network charges could be lower as 'base year' costs used to determine operational costs in future Access Arrangement reviews would reflect the lower cost of inspection.

3.2 Hydrogen network assessment

The primary benefit of substituting natural gas with hydrogen is a reduction in carbon emissions. This benefit arises where hydrogen is produced and consumed while releasing fewer carbon emissions than natural gas processing and consumptions.

The beneficiaries of lower carbon emissions would be gas consumers and more broadly the community, as the community bears the current cost of carbon reduction measures and the cost of the impact of greenhouse gas emissions (such as climate change).

Converting the existing natural gas network to supply hydrogen provides customers with advantages over decommissioning the network and relying entirely on electricity as a fuel source. Unlike electricity, gas networks have the capability to store fuel for use in peak times so, for example, hydrogen fuelled peaking plants can be used to generate electricity at time of peak electricity demand avoiding the need for electricity network augmentation. Customers also benefit from a diversity of energy sources. Gas networks are extremely reliable and can provide consumers with energy even when electricity supply is interrupted. A further benefit to customers arises from the sunk cost of gas networks. Converting networks to transport hydrogen allows ongoing use of a distributed asset without the need to significantly augment electricity networks to supply the energy currently transported by gas networks.

3.3 Water extraction camera

The primary benefits from the implementation of a water extraction camera are reduced supply interruptions and reduced length of supply interruptions.

Supply interruptions due to water ingress occur in particular areas where mains are susceptible and during wetter weather. The current approach to draining water from distribution mains is reactionary and involves waiting until a customer(s) experiences a supply interruption. When a supply interruption occurs, a fault-finding process involving checking the meter and regulator and determining the status of adjacent customer's gas supply proceeds. When the fault-finding process concludes that water is the cause of the interruption, a process of extracting the water from the pipeline is carried out. The positive identification of water ingress causing the interruption is not known until after the fault has been rectified. i.e. it is not until water is detected and cleared from the pipeline that the exact cause of the interruption is known.

The camera and water extraction system could be used to proactively remove water before interruptions occur. For example, in areas susceptible to water ingress due to their design and construction, and following a wet period, the camera could be used to identify whether water ingress has occurred and to remove that water before an interruption occurs. This would eliminate some supply interruptions.

The water extraction camera could also be used to decrease the time taken to both identify the location of water blockages and also reduce the time taken to rectify the fault by removing the water. When an interruption to supply occurred in an area susceptible to water ingress, the camera and water extraction device could be immediately deployed. Any water in the pipeline would be readily detected and immediately extracted leading to shorter duration interruptions. This would also minimise disruption to road, footpath, and property, as field staff would not have to excavate to remove the water in the main.

3.4 Portable storage system

The primary benefit from use of a portable storage system would be to enable supply to be maintained during planned work or during extended unplanned supply interruptions. A secondary benefit would arise from a potential reduction in the cost of undertaking planned or unplanned work on the network.

During some planned work it is not currently possible to economically maintain supply to all connected customers as, for example, the customers may be connected to a radial section of the network when a pipe supplying that network requires replacement. Similarly, if an incident such as damage to the pipeline occurs due to a dig-up, then customers may be interrupted for an extended duration while the repair is carried out. The time taken to repair a damaged pipe is influenced by a number of factors such as the location, the extent of the damage, the ease with which a repair crew can access the site etc.

A portable storage system would be used to supply customers during these planned or unplanned supply interruptions. The system would be located at a position on the network where supply to a defined group of customers could be isolated and the portable system would then be connected to supply affected customers while planned or unplanned work is undertaken. During planned work, it is anticipated that the portable system could be connected without customers' experiencing a supply interruption. The reduction in the number or duration of supply interruptions has direct benefit to customers.

Where the portable storage system was deployed to enable planned work, it is possible that it could reduce the cost of some works. Presently, where planned work results in supply interruptions, efforts are made to minimise the impact on customers by timing the work when it is likely to have least impact on customers or utilising larger or multiple crews carry out the work quickly so that supply interruptions are short. Timing the work to have the least impact on customers may result in additional costs such as overtime costs. Utilising larger or multiple crews adds to the cost of the work. Utilising a portable storage system could reduce these costs and customers would benefit through lower network charges in future Access Arrangement reviews would reflect the lower cost of works.